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Conservation Subdivision: Construction Phase—Native Landscaping Palette[1]

Mark E. Hostetler and Martin B. Main[2]

Introduction

Figure 1. Stokes Aster *(Stokesia laevis)*, a flowering native plant that can be used in landscaping.
Credit: Tyler Jones, UF/IFAS

As urban communities grow, design and management strategies for new developments become critical factors that determine impacts on natural resources. How can we accommodate growth and yet conserve natural resources, such as biodiversity, water, and energy? In this document, we focus on conserving biodiversity when land is subdivided. The term biological diversity or *biodiversity* refers to the variety of life and its processes. Biodiversity includes species diversity, habitat diversity, and genetic diversity. For the purposes of this article, we focus on biodiversity of *native* species. Native species are plants and animals that were present within a specific region before Europeans made first contact. Non-native (or exotic) plants or animals are defined as those species that were not present in the region before European contact (Florida Native Plant Society 2003).

Recently, a popular concept called *clustered development* or *conservation subdivision* has been advanced by the landscape architecture community. Conservation subdivision is intended to integrate growth with biodiversity conservation. Conservation subdivisions typically are developments where homes are clustered on small lots with the remaining areas conserved as open space.

The concept of conservation subdivision has gained traction in many planning and design fields. The goals for conservation subdivisions are twofold: 1) to improve biodiversity within a designated subdivision; and 2) to minimize development-related impacts on surrounding habitats. Often, though, most of the effort is on the design of the entire site. To conserve and improve biodiversity within urban environments effectively, one must consider the following three phases of development: design, construction, and post-construction.

The design phase is typically where, among other aspects, lot size and open space are designated, and roads are distributed throughout the site. Goals for the development project are discussed and prioritized. In this phase, homes and lots are placed across the site and the remaining area designated as (natural) open space. Basically, everything is laid out on paper and vertical structures (buildings) and horizontal structures (roads, lots, conserved areas, and shared spaces) are given specific spaces within the development.

Next, during the construction phase, a whole host of built environment professionals including architects, contractors, and subcontractors take whatever is on paper and implement this on the ground, constructing homes, streets, waste treatment systems, and landscaped areas (i.e., yards and parks). In the absence of fully trained or engaged contractors or landscapers, many things can happen during this phase that could impact the viability of onsite and nearby natural habitat. For example, even if the most important large trees are preserved across the subdivision and built areas are designed around them, the placement of topsoil and routes used by heavy construction vehicles could impair the survival of these trees. If heavy vehicles continually run over the root zone of a tree or if topsoil is placed against the tree trunk, the roots may not be able to acquire nutrients, water, and oxygen and the tree may die.

In the final phase, post-construction, buyers purchase the homes, move into the community, and manage their own homes and yards, neighborhoods, and common areas. It is now the responsibility of residents to manage their homes, yards, and neighborhoods in ways that do not compromise

the original intent of the community. Additional problems can arise if residents are not fully engaged—imagine residents moving in and planting invasive exotic plants in each of their yards. Residents could also improperly apply fertilizers and pesticides. The spread of invasive plants and stormwater runoff could then destroy or at least severely reduce the diversity of animals and plants found in the conserved areas.

Overall, these three phases must be addressed in order to create and maintain biodiversity within residential subdivisions. The EDIS documents in the series titled "Conservation Subdivision" discuss biodiversity conservation pertaining to all three phases of development: design, construction, and post-construction. This fact sheet focuses on decisions made in the construction phase. During the construction phase, landscape architects and contractors are hired to install landscaping on lots and shared spaces. Landscaping can be composed of a variety of different plants from exotics to natives. Below, we discuss the importance of emphasizing native plants when selecting a landscape palette.

Landscaping Palette Considerations

The types of plants selected for landscaping, such as native vs. exotic plants, have consequences for Florida's biodiversity. Florida is a state rich in biodiversity. There are about 700 native vertebrate species (animals with skeletons, like birds and mammals); 2,850 native plant species; and at least 15,000 native invertebrate species (animals without skeletons, such as insects). Of these, several are endemic to Florida, which means that these species are found nowhere else in the world. Florida has one of the highest numbers of endemic plants in the United States: about 224 plant species are found only in Florida (Wunderlin and Hansen 2008); 14 species of birds, reptiles, amphibians, and mammals are endemic (Landscope America 2009); and 1,500 species of invertebrates are endemic (Landscope America 2009).

But do non-natives also contribute to biodiversity, even though they are exotic species? Yes, they do. However, it is important to think about global biodiversity. As we mentioned earlier, Florida has about 2,850 native plant species and of these about 224 endemic species are found nowhere else in the world. Let's say we completely replace 1,000 native species with non-native species in the state of Florida. In this situation the total number of species would stay the same but we lost 1,000 native species. If some of these were Florida endemics that were eradicated, then not only Florida but the entire world will have lost some species forever. Packing in more exotic species merely spreads globally common species to more places and limits local native diversity (Seabloom et al. 2006; Lodge 1993). The end result would be that one would begin to see the same exotic plant species in cities throughout the world, often at the expense of local natives.

Biodiversity benefits people in many ways. In terms of a utilitarian value, food, fiber, medicines, and just about everything we use on a daily basis benefit from biodiversity. In addition to material goods, biodiversity provides ecological benefits such as clean air and water, and it provides recreational, social, and aesthetic benefits as well as economic opportunities. People derive social and health benefits from local natural habitat and wildlife. In a national survey in 2001, nearly 41.8 million people indicated that they watched birds around their home (US Department of the Interior 2006). Even the sense of place is linked to the presence of wildlife; for example, over 80% of property owners near lakes in Wisconsin indicated that an element of their satisfaction with the place where they live was the ability to see wildlife populations (Stedman, 2003). A spiritual value is often attached to the natural world. Coined *biophilia*, the natural environment is regarded by people as a source of beauty, inspiration, and rejuvenation (Kellert and Wilson 1993). Physical and mental health benefits exist as well. For example, nearby natural areas help to protect children from the impact of life stresses—children with access to natural environments had superior cognitive functioning, fewer physical ailments, and speedier recovery from illness (Wells and Evans 2003). Finally, biodiversity has an intrinsic value, which refers to the right of all living things to exist and our responsibility to respect that right—regardless of a species' utilitarian value. For a more thorough discussion about why biodiversity is important, see the synthesis document published through the American Museum of Natural History's Center for Biodiversity and Conservation (Sterling et al., 2003).

As mentioned above, Florida truly has some unique animals and plants! The conventional approach of landscaping with exotic turf and ornamentals harms biodiversity in two ways: 1) it limits the diversity of native species in areas dominated by turf and ornamentals, and 2) it can alter surrounding natural environments, changing habitats in ways that exclude native plants and animals. Let's first look within the city limits. How do exotic plants impact urban biodiversity? Simply put, an urban landscape dominated by turfgrass and other exotic plants creates an artificial environment that offers very little opportunity for native species to thrive. A monoculture of turfgrass infused with non-native ornamentals excludes native plants and provides little to no habitat for wildlife. Think about the vast amount of land devoted to turf, both for growing the sod and the amount of sod that occurs on the landscape as urban lawns. One estimate indicates that 163,812 km^2 of managed turfgrass occurs in the United States (https://legacy.geog.ucsb.edu/the-lawn-is-the-largest-irrigated-crop-in-the-usa/). Such acreage limits the amount of natural habitat, thus decreasing urban habitat diversity and ultimately native species diversity on land dominated by turf.

However, people can improve biodiversity by landscaping with a variety of native plants, which benefits our native wildlife and plant diversity. For example, native urban bird diversity increases with increases in native vegetation (Mills et al. 1989; MacGregor-Fors 2008); more native plants serve as host plants for butterfly larvae (Daniels et al. 2008; Collinge et al. 2003); and native bee diversity increases with the occurrence of native plants (McIntyre and Hostetler 2001). Although some exotic plants, particularly trees and shrubs, can provide food and shelter for some animals (for instance, an exotic butterfly bush, *Cassia bicapsularis,* provides nectar for some native butterflies), it is fair to say that the negatives of a landscape dominated by exotic plants far outweigh the positives for wildlife. First, the exclusive use of non-native plants would ultimately decrease native plant diversity because of the simple fact that native plants are absent from the area. Second, native animal diversity, in general, is correlated to native vegetation diversity (e.g., Burghardt et al. 2009). Overall, landscaping with many different native plants improves urban biodiversity by simultaneously creating wildlife habitat and increasing the presence of native plants in urban areas.

Turfgrass and ornamental plants used in subdivisions can decrease the biodiversity of surrounding habitat outside the boundaries of those subdivisions. Non-native plants originally used as ornamentals in urban areas have escaped and become established in surrounding natural habitat. Non-native species that invade natural areas are called *invasive exotics.* An invasive exotic plant often "alters native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives" (Florida Exotic Pest Plant Council 2007a). The establishment of an invasive exotic plant in natural areas can dramatically impact native plant and animal communities both within and outside of city limits. Native animals cannot thrive in areas dominated by invasive exotic plants; for example, fewer small mammals were found in forests dominated by Melaleuca, *Melaleuca quinquenervia,* when compared to native hammock forests and pine flatwoods in Florida (Mazzotti et al. 1981; Sowder and Woodall 1985). Many plants introduced to Florida as landscape ornamentals have since escaped into natural areas and become invasive exotics (https://assessment.ifas.ufl.edu/). A few examples include Coral Ardisia (*Ardisia crenata*); Chinese Privet (*Ligustrum sinense*); and Melaleuca. All of these plants can dominate a habitat and displace native plant communities. Also, non-native plants may hybridize with native species, causing the eventual decline of a particular genotype. In Florida, ornamental Lantana *(Lantana aculeataromote)* can hybridize with native Lantana (*Lantana depressa*) (Florida Exotic Pest Plant Council 2007b), compromising the genetic diversity of this species. Overall, a risk is incurred with the use of *any* exotic plants because almost all of our identified invasive-exotic plants have originated from ornamentals used in urban environments (Florida Exotic Pest Plant Council 2007a). Exotic plants are continually evaluated and the IFAS Assessment of Non-native Plants is a good place to see which plants are designated as invasive. We are not saying that all non-native plants are necessarily bad, but today's non-listed exotic could become tomorrow's invasive species.

Both within and beyond city boundaries, the maintenance of lawns and exotic plants with an array of insecticides, fertilizers, and herbicides can reduce biodiversity. Most people use insecticides and herbicides to keep other plants out of lawns and gardens. The end result is usually the eradication of native plants and insects. For example, many insecticides used to kill pest species of ornamental plants are not specific to the target insect and kill many of our native pollinators such as bees, beetles, wasps, and butterflies (Kunkel et al. 2001; Gels et al. 2002). Applying herbicides to get rid of "weeds" reduces biodiversity of your yard simply because the weeds are probably native plants embedded within landscaped and turf areas. For example, many herbicide applications are used for the removal of the native plant Florida Betony, *Stachys floridana,* which is sometimes called "rattlesnake weed" (https://edis.ifas.ufl.edu/publication/EP597). Herbicide application, if administered improperly, can impact a variety of native species. The active ingredient in Roundup®, isopropylamine, was found to be toxic to native freshwater mussels (Bringolfet al. 2007) and lethal to both aquatic and terrestrial amphibians (Relyea 2005a). The end result is a net native biodiversity loss because local native plants and animals can be eradicated from a yard or neighborhood, a nearby waterbody (Relyea 2005b), and even surrounding natural habitat.

How do fertilizers impact biodiversity? Excess fertilizers (for instance, phosphate and nitrate that are not taken up by the landscape) end up in local wetlands and waterbodies when nutrients run off the landscape after storms. In one study on the Florida Wekiva River Basin, it was estimated that 15%–20% of the nitrate load was from residential properties (see report at https://lake.wateratlas.usf.edu/upload/documents/final-report-2010-wekiva-basin-nitrate-sourcing-fr0310.pdf). High levels of nitrates and phosphates cause algal blooms (Lin et al. 2008), fish kills (Gannon et al. 2009), and the growth of invasive exotic plants (e.g., Sutton et al. 1992) in rivers, streams, and lakes. Near major population centers, the disturbing appearances of "dead zones" in our coastal waters have been linked to nutrient runoff from the land (Diaz and Rosenberg 2008). Dead zones are hypoxic, or devoid of oxygen, and very little marine life survives in areas that become hypoxic for long periods of time.

As discussed, urban turfgrass and non-native ornamental landscaping not only reduces urban biodiversity, but it can also affect surrounding environments. Many intricate connections and resilience factors exist between the physical environment and local, native organisms.

Replacing a diversity of native species with a few exotics (or even a few native species) may have many unforeseen consequences. Biodiversity loss can even affect important ecosystem services, such as removal of carbon dioxide (CO_2) and pollination. More biodiverse ecosystems have been shown to take up more CO_2, a greenhouse gas, than ecosystems with less species diversity (Reich et al. 2001); thus, a biodiverse ecosystem can actually help take more CO_2 out of the atmosphere and help decrease the likelihood of climate change. Furthermore, native insects help in food production by pollinating nuts, fruits, and vegetables (Winfree et al. 2008), and native pollinators are economically important to agriculture (Gallai et al. 2009). A diversity of pollinating insects is more resilient to factors that could wipe out local populations. Consider our reliance on European honey bees (*Apis mellifera*) for pollination of citrus groves and other agricultural crops in Florida. The honey bee population is currently being decimated by a number of factors, including parasitic mites and pesticides (Buchmann and Nabban 1996). Agriculture has long relied on European honey bees to pollinate crops, but because these managed hives are failing and honey prices have decreased, farmers are beginning to have to scramble to get their crops pollinated. Farmers have overlooked the value of local insect pollinators. Populations of native pollinating insects have been decimated through years of insecticide use and habitat destruction (Buchmann and Nabban 1996). As a result, they cannot take over the pollination services provided by the European honey bee. Agricultural operations are now trying to bring about the return of native pollinators (Vaughan and Black 2006). Conservation subdivisions can help: urban neighborhoods located near agricultural fields provide critical habitat for insect pollinators. Making subdivisions friendly to native insects helps pollinate food crops right next door, and neighbors reap the added benefit of viewing unique insects in their backyards!

In summary, an exotic plant landscaping palette decreases urban biodiversity and can harm nearby native plant and animal communities. The population of Florida is projected to reach 36 million people by 2060, and urban areas are projected to vastly expand (Zwick and Carr 2006). Even the most protected natural areas are going to be surrounded by urban areas. Because urban areas are a dominant feature within Florida, what we do in our own homes, yards, and neighborhoods can dramatically affect biodiversity throughout the entire state! As we transform landscapes with urbanization and residential development, we must find ways to make these urbanizing landscapes more ecologically friendly. Using a native plant landscaping palette is one action to improve urban biodiversity and minimize our potential impact on surrounding habitats. Below are some landscaping considerations for constructing lots in new subdivisions:

- Reduce or eliminate turfgrass lawns. A number of native groundcovers and even low-maintenance (native or exotic) ground covers are available.
- Plant the appropriate native vegetation. Be sure to inspect your soil and evaluate the shade/sun and water conditions of your site. Usually you need a local soils expert to identify the types of soil on your site. The right plant for the local soil type can be found at Natural Resource Conservation Service (NRCS, https://nrcs.usda.gov/) and through local UF/IFAS Extension offices (https://sfyl.ifas.ufl.edu/find-your-local-office/). This is relevant because certain plants do well in particular soils. You want to get the right plant in the right place because different plants work well in different areas. When using native species, it is preferable to use a local representative that has a local genetic makeup. This preserves the genetic integrity of local populations and helps contribute to regional biodiversity.
- Increase vertical height diversity of vegetation because the variability in heights attracts a wider variety of wildlife species.
- Create larger patches of natural habitat in the landscaping plans. Many wildlife species need large patches in order to survive.

Additional Resources

For additional information on conservation subdivisions and conserving urban biodiversity, a variety of online guides, books, and other publications exist.

Books and Scientific Publications

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Florida Fish and Wildlife Conservation Commission—Planting a Refuge for Wildlife
https://myfwc.com/viewing/habitat/refuge/

UF/IFAS Assessment of Non-native Plants in Florida's Natural Areas https://assessment.ifas.ufl.edu/

Living Green https://livinggreen.ifas.ufl.edu/

Program for Resource Efficient Communities
https://sfyl.ifas.ufl.edu/sustainable-communities/community-planning--development/

Sustainable Site Initiative
https://www.sustainablesites.org/

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[2] Mark E. Hostetler, professor and Extension specialist, Department of Wildlife Ecology and Conservation; Martin B. Main, professor, Department of Wildlife Ecology and Conservation and director, Florida Master Naturalist Program; UF/IFAS Extension, Gainesville, FL 32611.